Obarvovací hra

Pavel Stříž, pavel@striz.cz

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OSSConf, 1. – 3. 7. 2025

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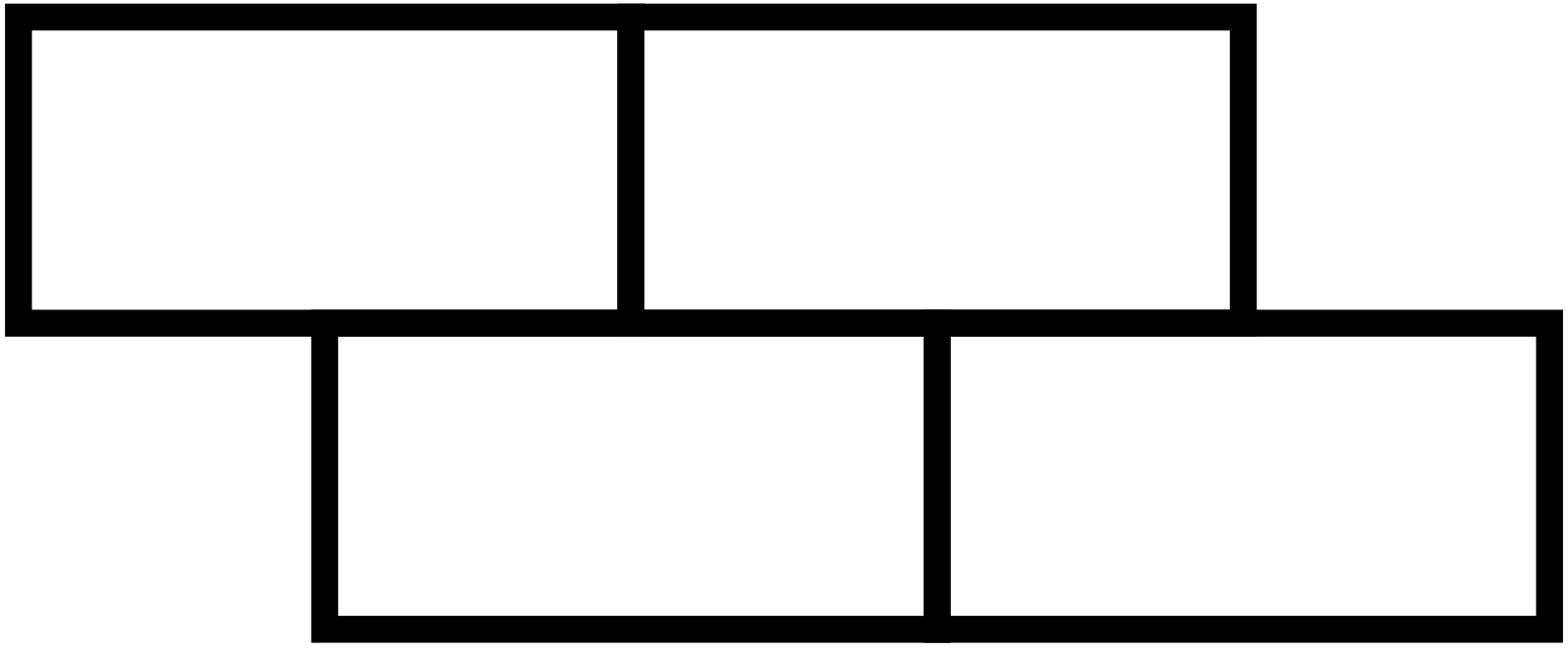
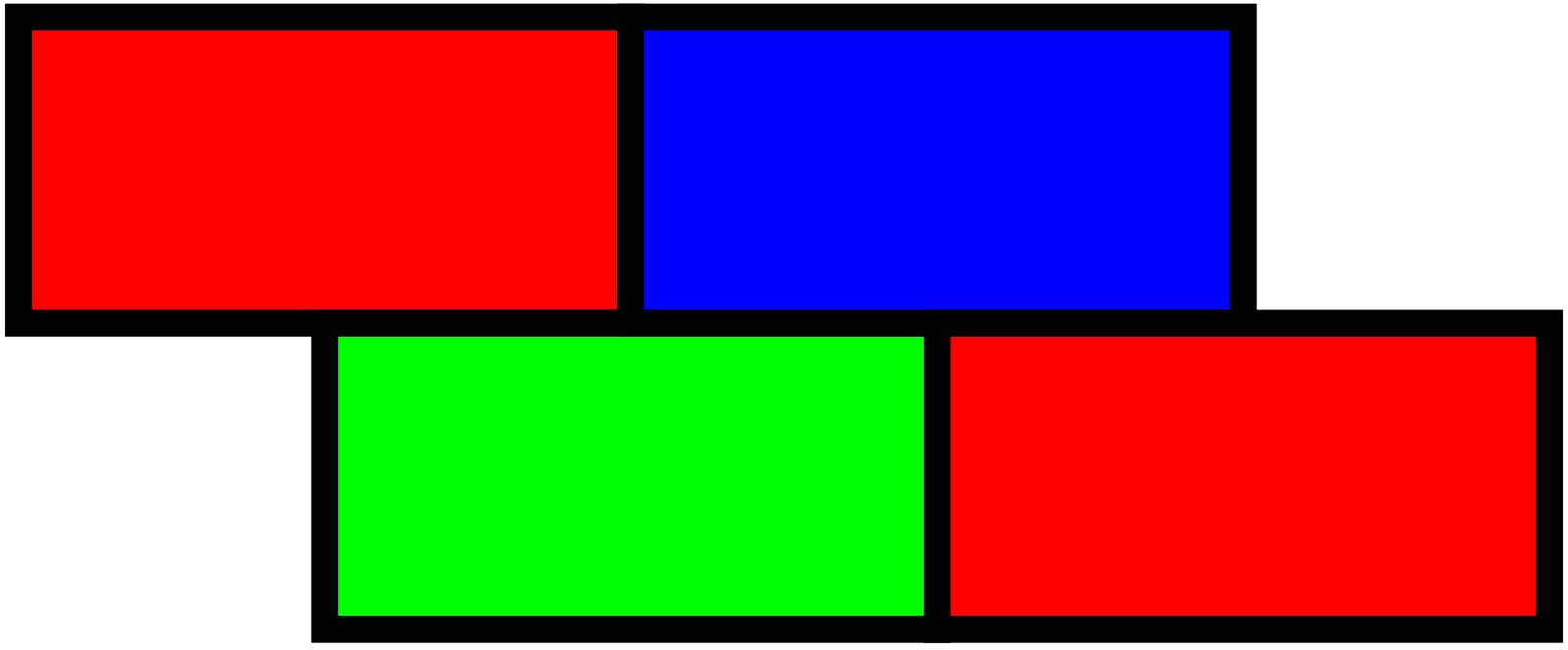
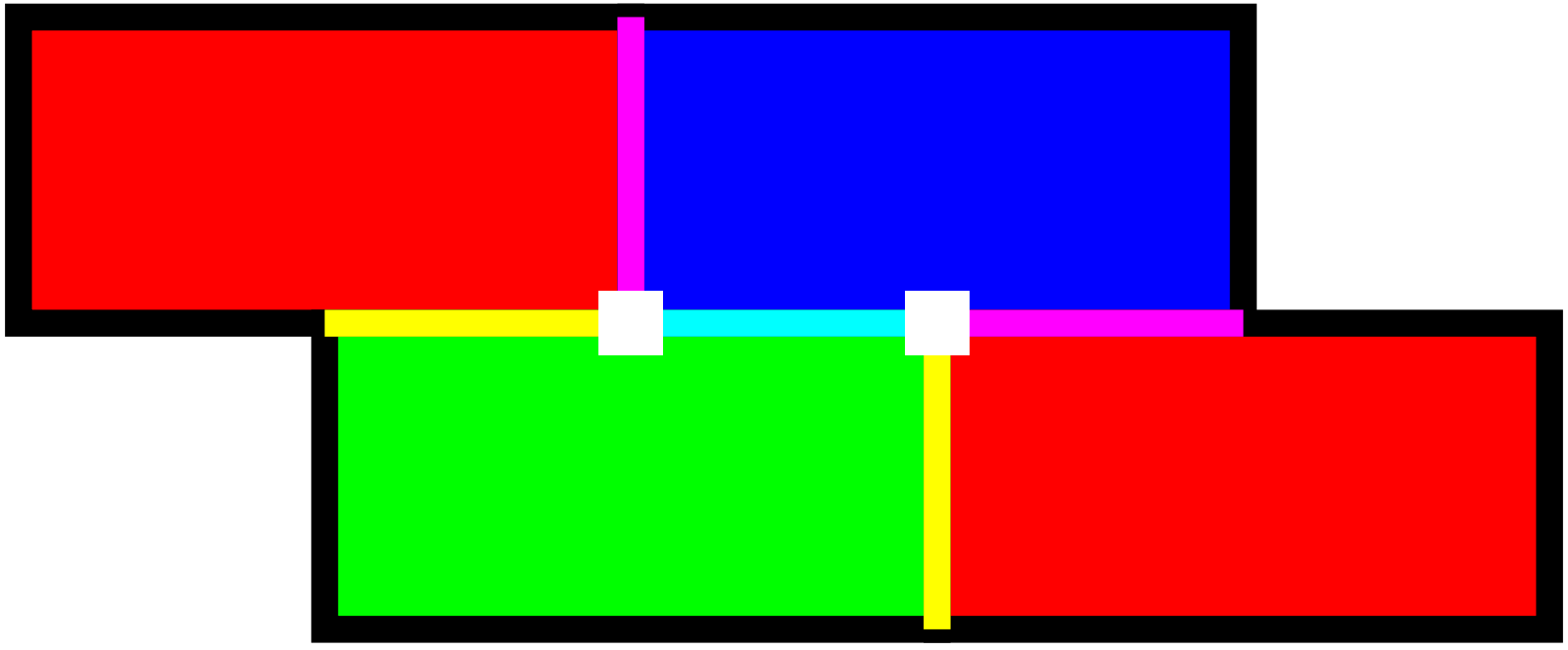
Obarvovací hra, jakože ČR+SR



Obarvovací hra, jakože ČR+SR



Obarvovací hra, jakože ČR+SR



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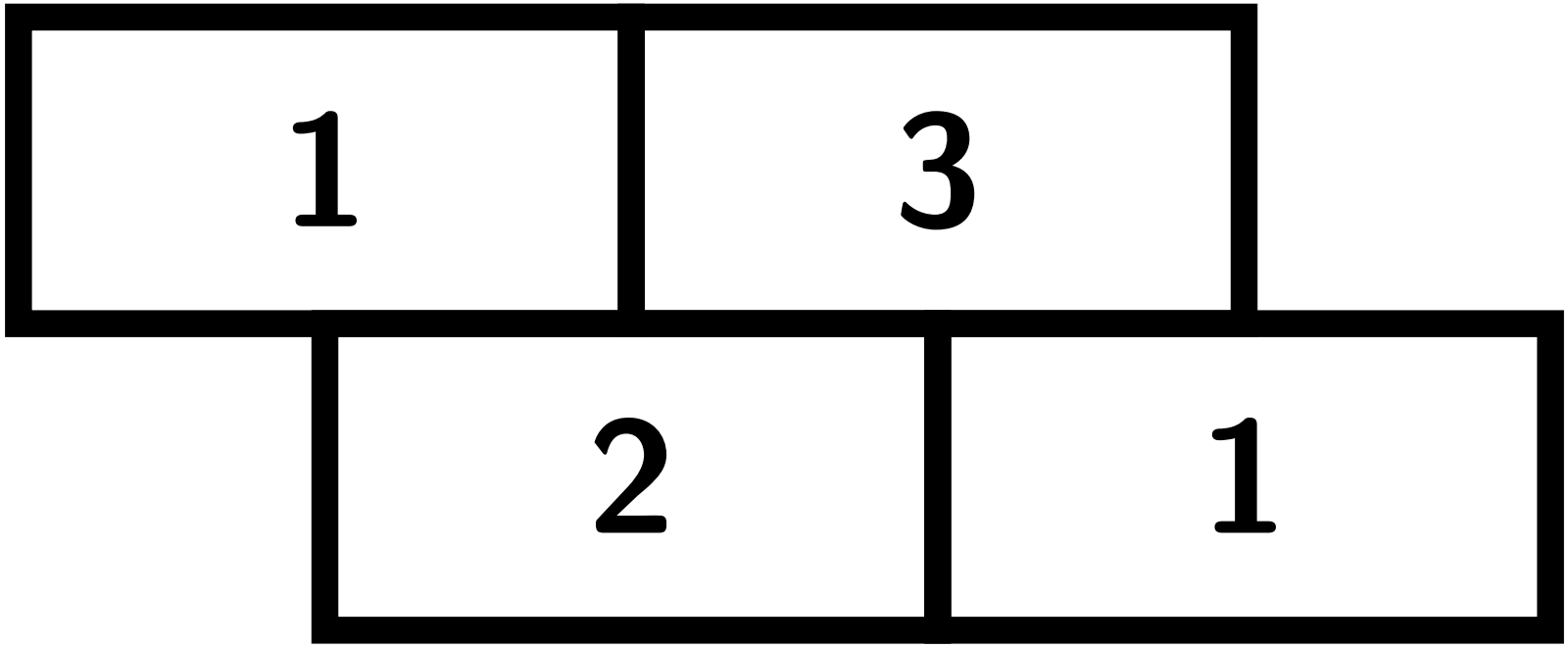
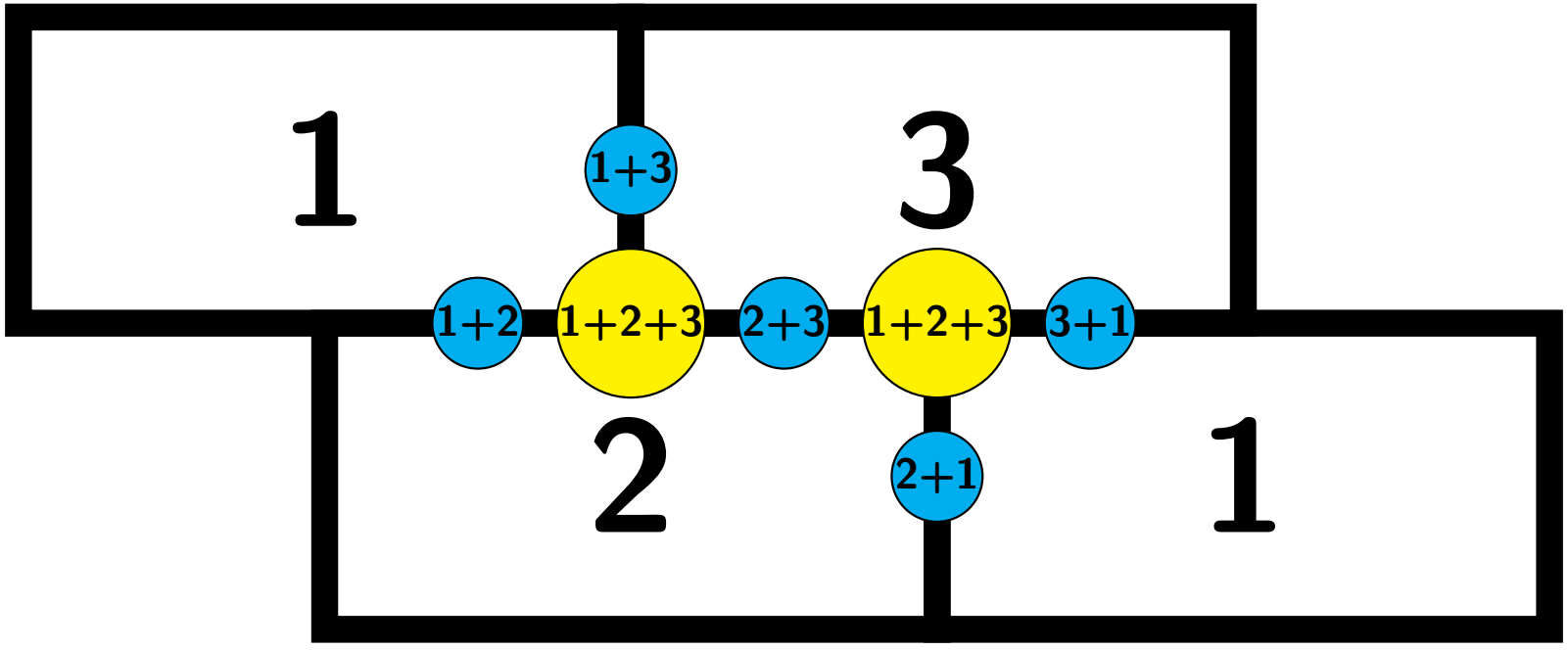
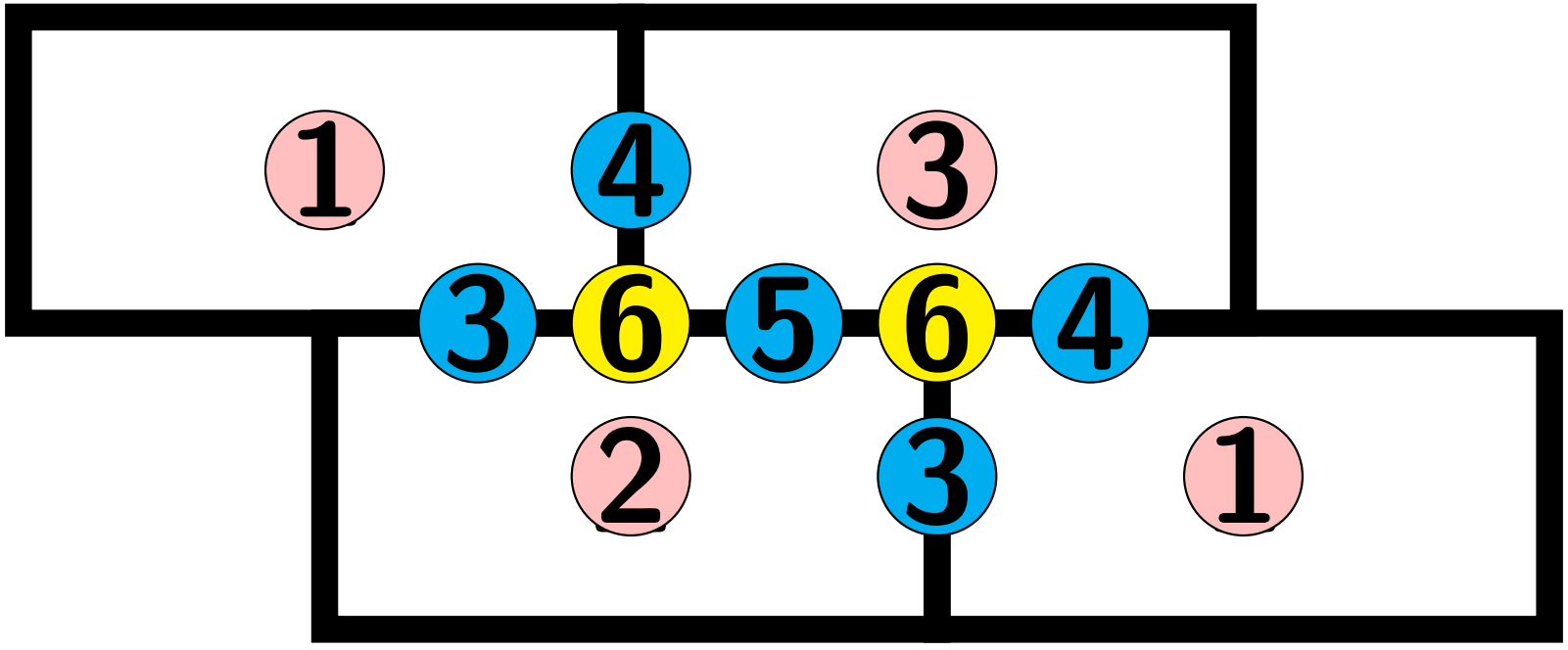


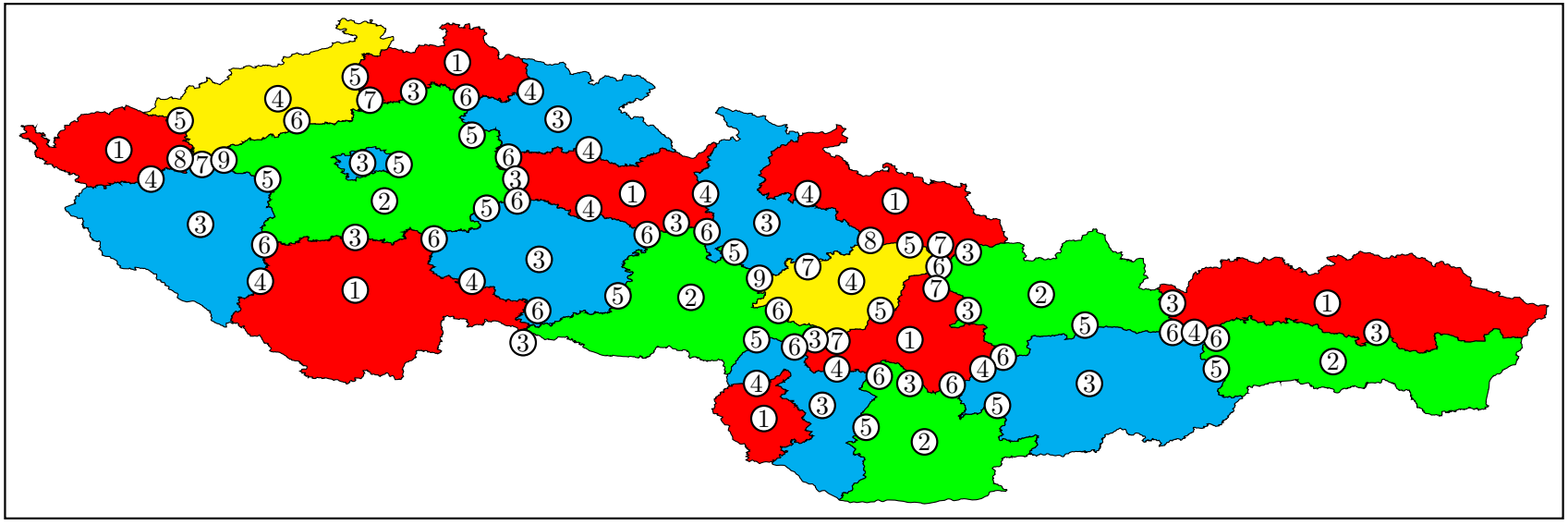
Obarvovací hra, jakože ČR+SR



Obarvovací hra, jakože ČR+SR



Reálná mapa: řešení na zadání



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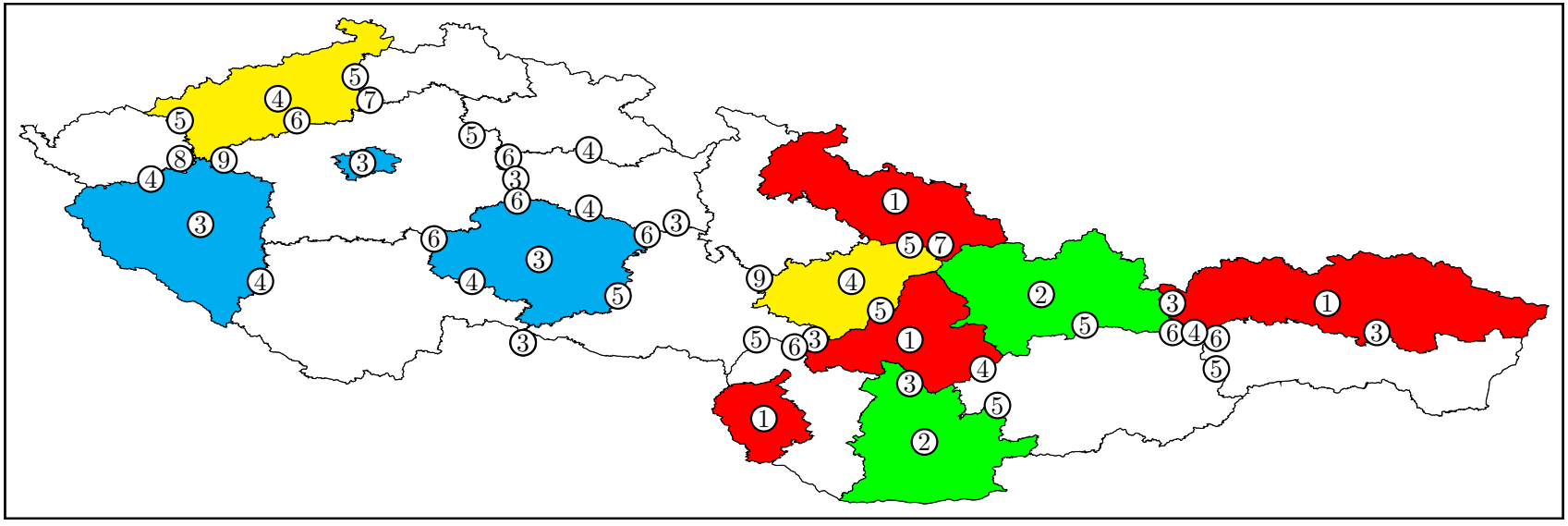
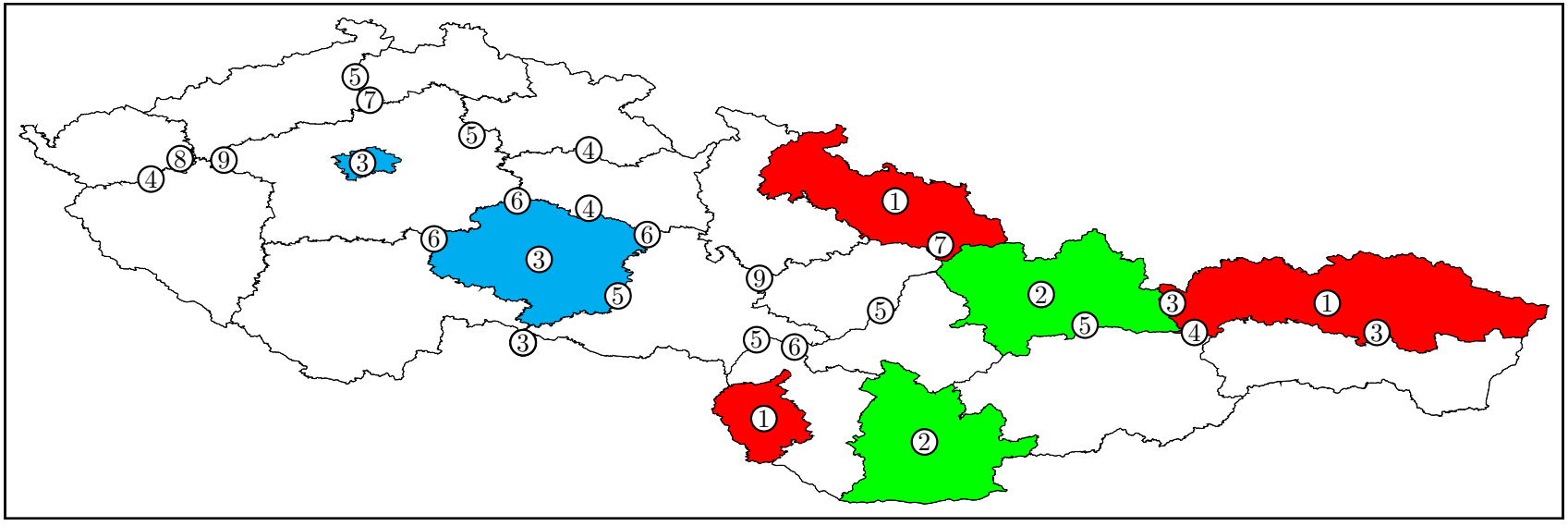
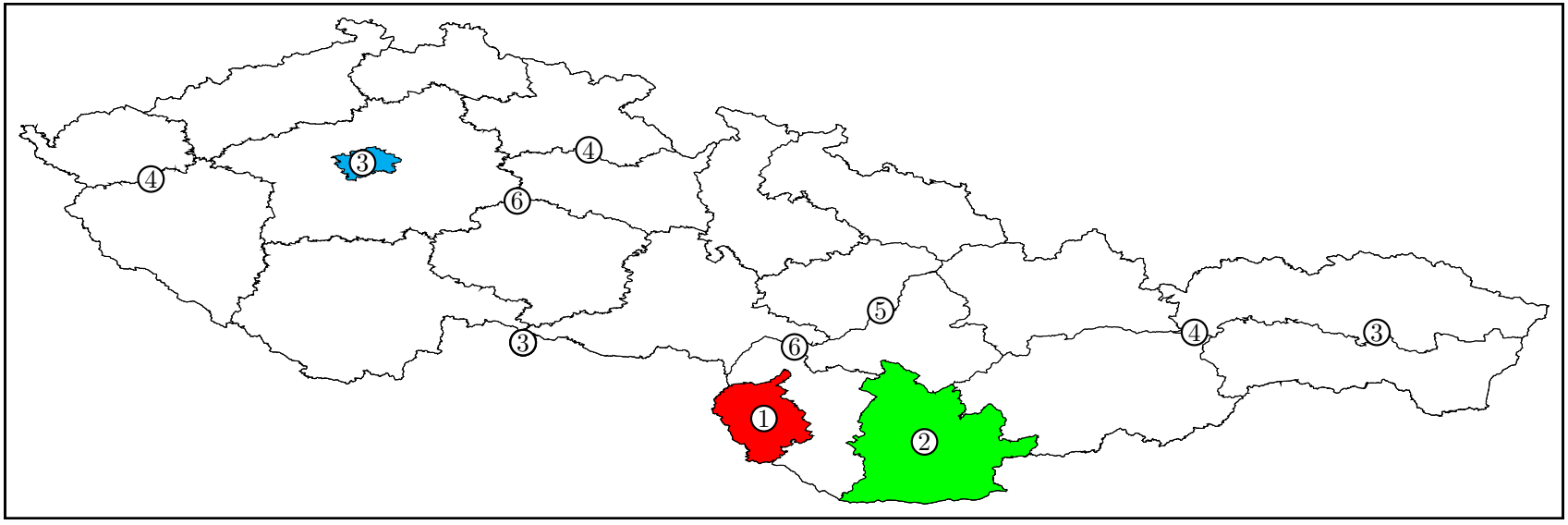


Reálná mapa: řešení na zadání

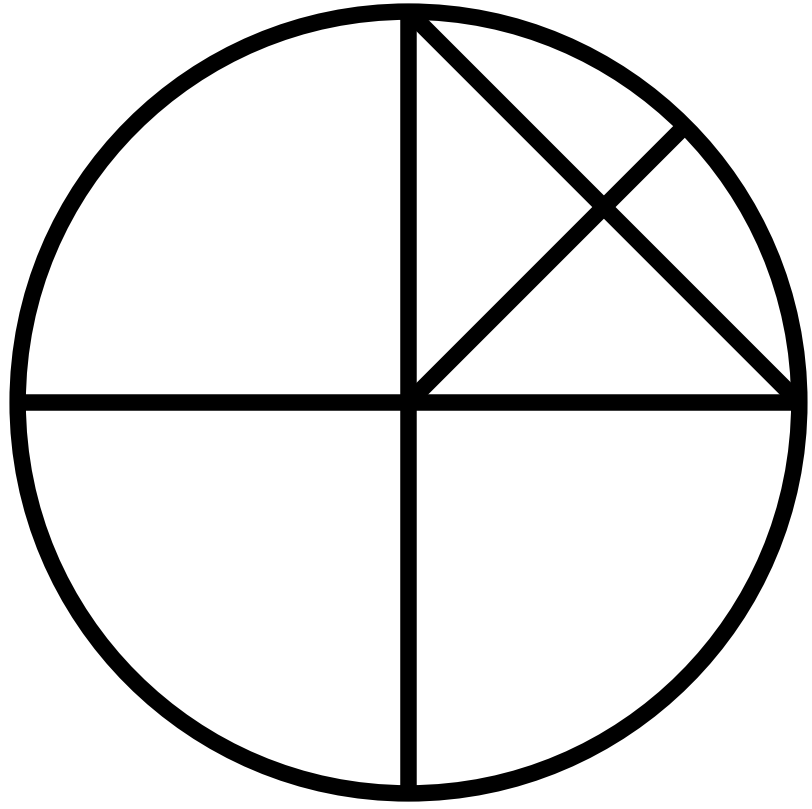


Reálná mapa: řešení na zadání



Úkol

Vyzkoušet fiktivní mapy a zkusit jejich hratelnost.



Otevřená otázka:

Lze na úrovni měst najít bod o 4 sousedech?

Kraje ani okresy ČR a SR nemají, maximálně 3.

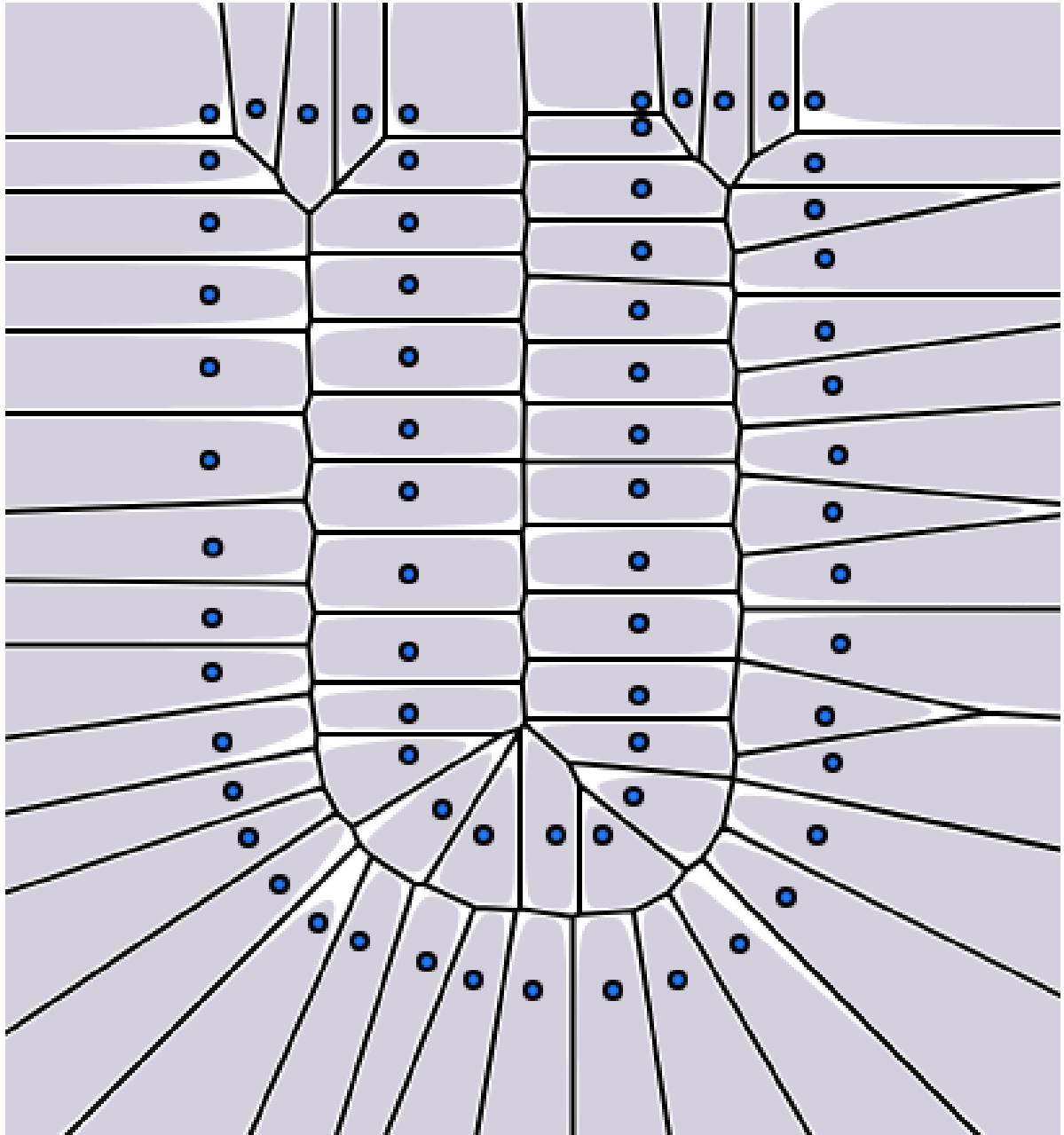
Optický střed hranice

Optický střed oblasti

Jinými slovy: hledáme místo, kam umístit popisek.

- Zkusit těžiště na reálné mapě. Nefunguje častokrát u znaků.
- Není-li to ono, najít kostru oblasti (Voronoi diagram) a najít nejbližší bod těžišti.
- Není-li to ono, ručně zasáhnout.
- Pozn. Symetrie oblasti může a nemusí pomoci.

Písmeno U: voronoi-editor.web.app

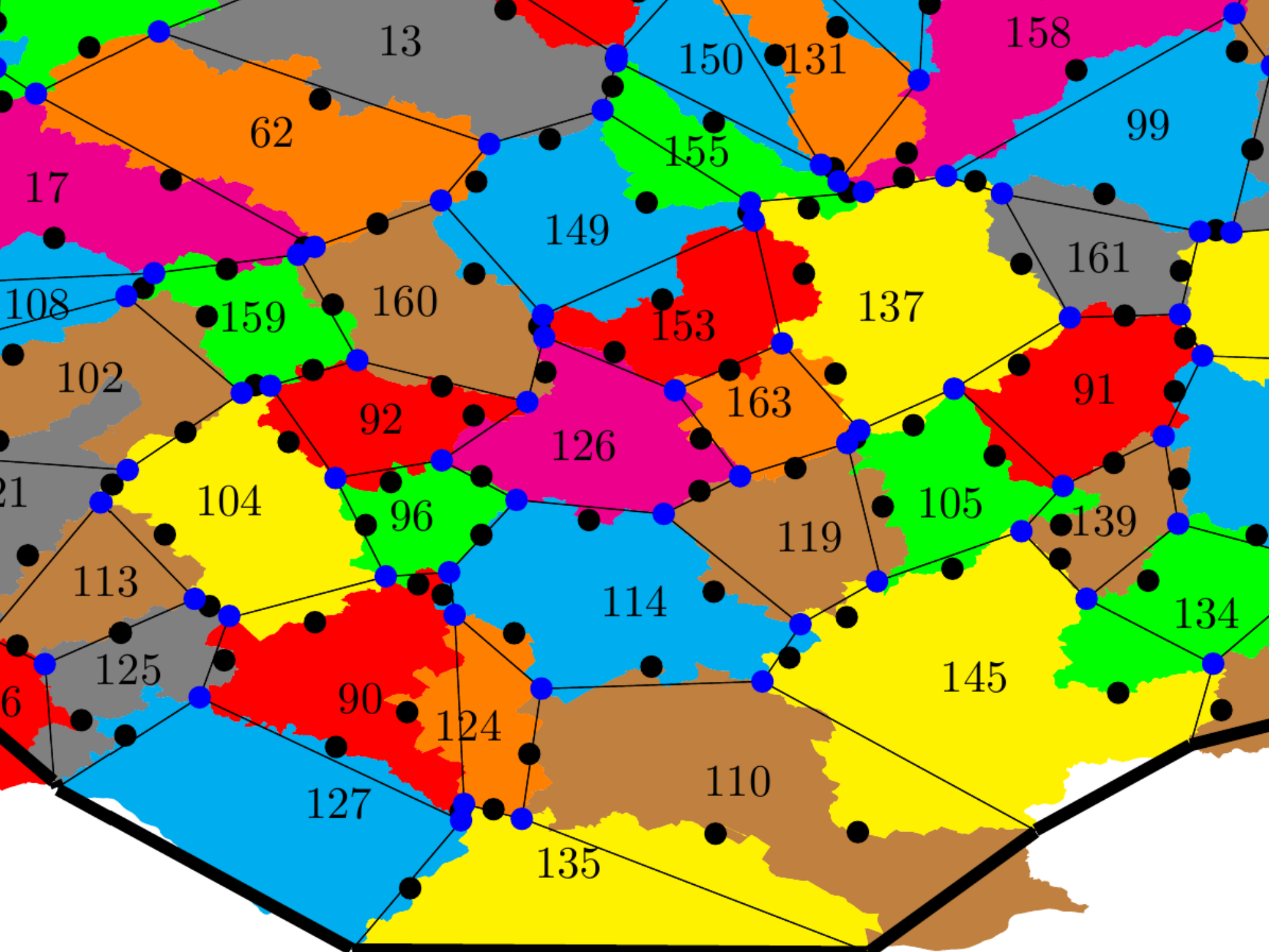


Optický střed hranice dvou oblastí

Docela výzva...

Zvolený postup:

- Nalezneme krajní body společné hranice.
- Ty spojíme úsečkou.
- Dopočítáme střed úsečky.
- Sestrojíme kolmici k této úsečce procházející jejím středem.
- A vůči této kolmici najdeme nejbližší bod na hranici.
- Je-li nalezených bodů více, tak volíme ten nejbližší středu úsečky.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Jsou-li otázky. . .

Concorde TSP Solver

Pavel Stříž, pavel@striz.cz

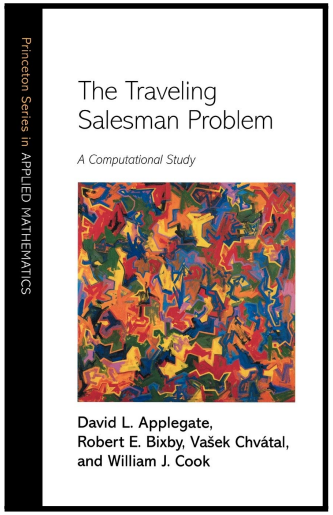
OSSConf, 1. – 3. 7. 2025

O TSP

- Problém obchodního cestujícího (optimalizace).
- Navštívit všechny uzly právě jednou.
- Hamiltonovský cyklus.
- Nejtěžší třída problémů.
- Užití v dopravě, na CNC strojích, ...

O programu

- `https://www.math.uwaterloo.ca/tsp/concorde.html`
- Užívá efektivně heuristické algoritmy, vlastní, viz kniha *The TSP: A Computational Study*.



- Lze užít heuristiku LKH.
- Nebo heuristiku Domino-parity.
- Pracuje s formátem TSPLIB.

Prof. Vašek Chvátal

- Sympaťák, náš člověk: hacker.
- Jeden z autorů Concorde.
- Spáchán s ním rozhovor, viz sborník.

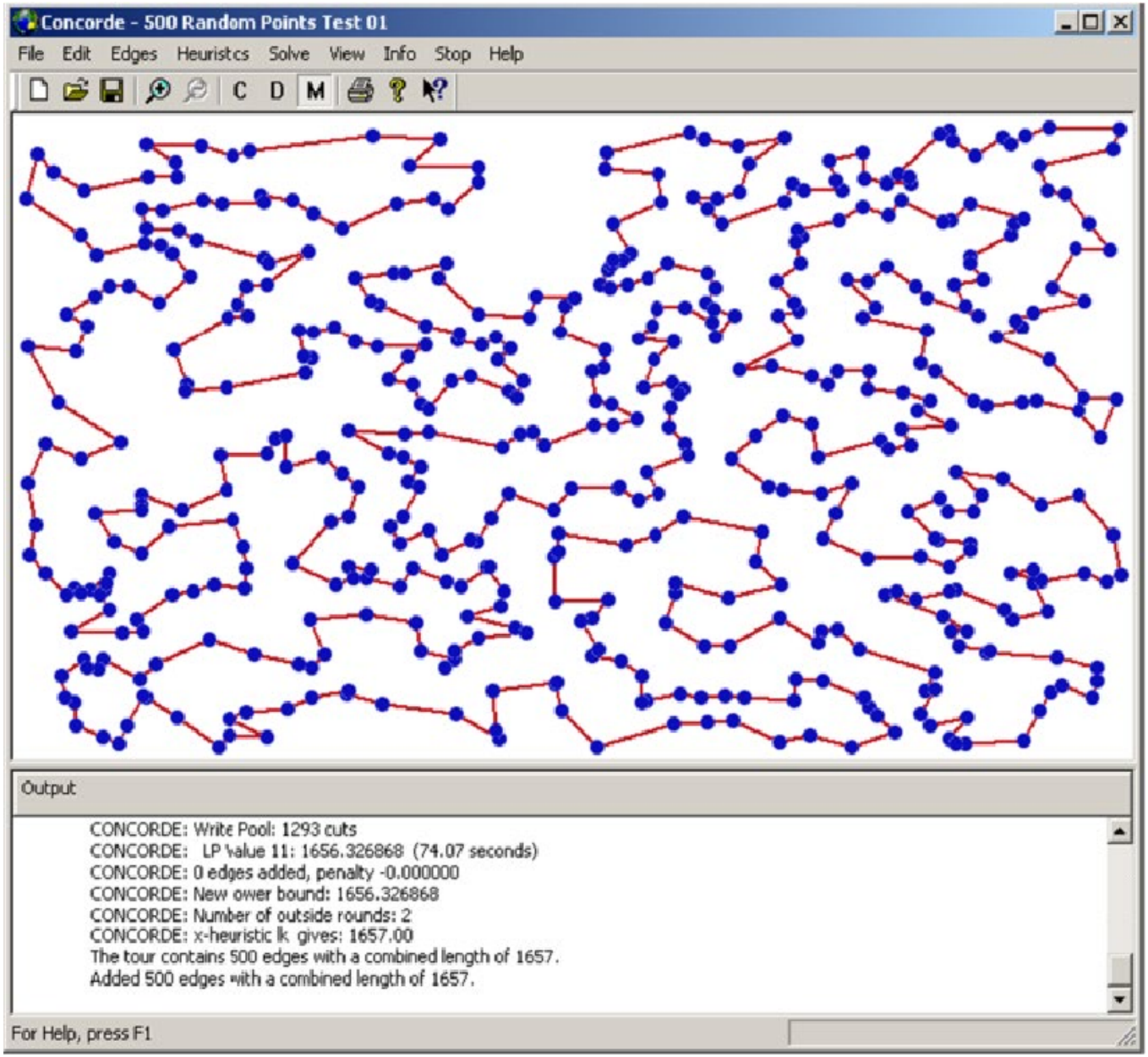
V článku

- Spuštění binárek; instalace ze zdrojových kódů.
- Přes R, knihovna `tsp`. Měli tam chybičku...
- Přes NEOS v R, knihovna `rneos`.
- Přes NEOS v Pythonu, balíček `neos_client`.

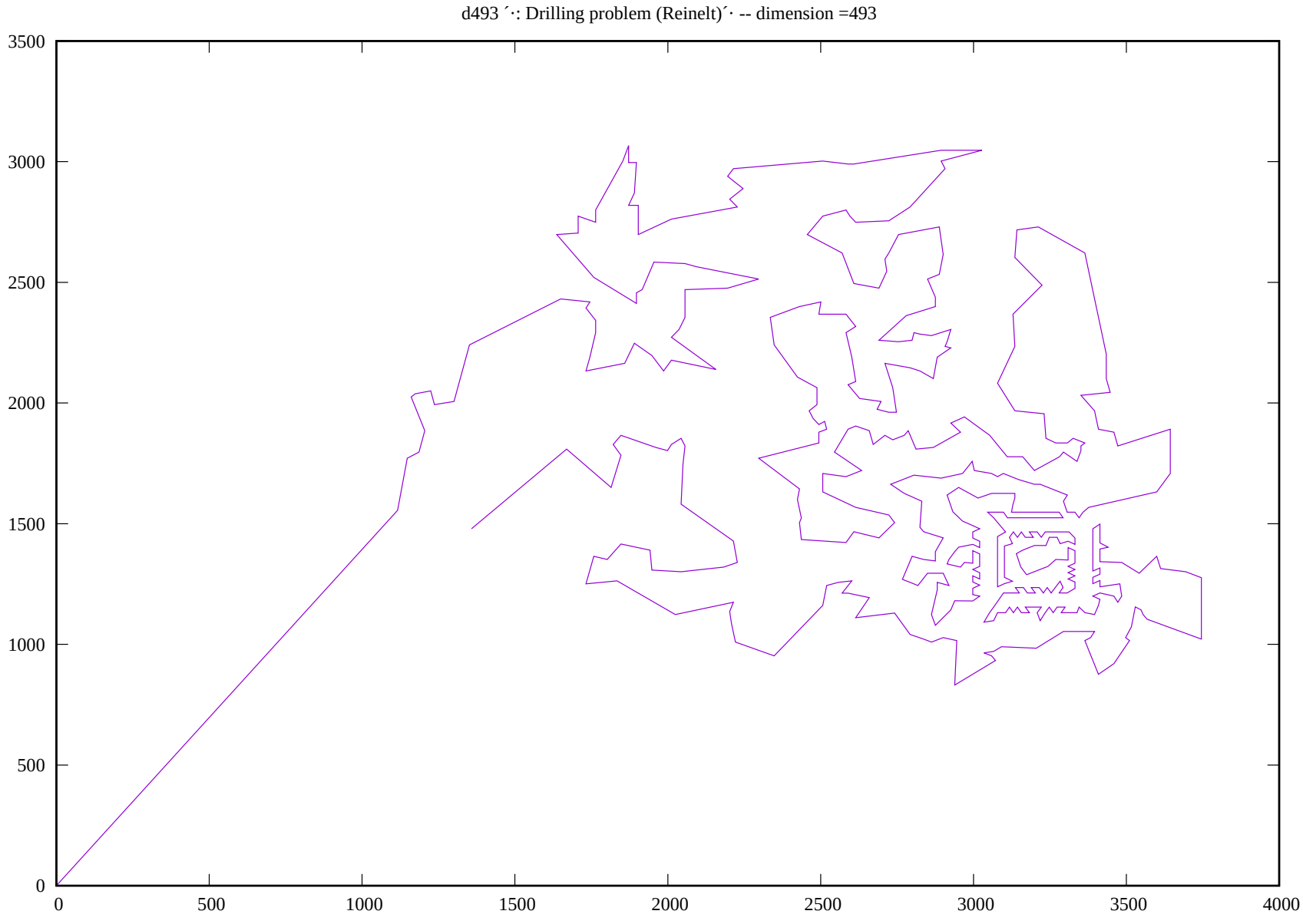
Brzký úkol

- Vykreslit výstupy z Concorde vektorově. První pokus je 10 let starý (Lua, pgfplots).
- Jsou nápady na vylepšení:
  - Uzly se nesmí překrývat.
  - Přes Ti*k*Z a automatické zmenšení uzlů.
  - Cifry uvnitř hran bez bílého pozadí.
  - Automatický posun cifry na hraně.
- Mělo by být ve formě článku pro bulletinek České statistické společnosti.

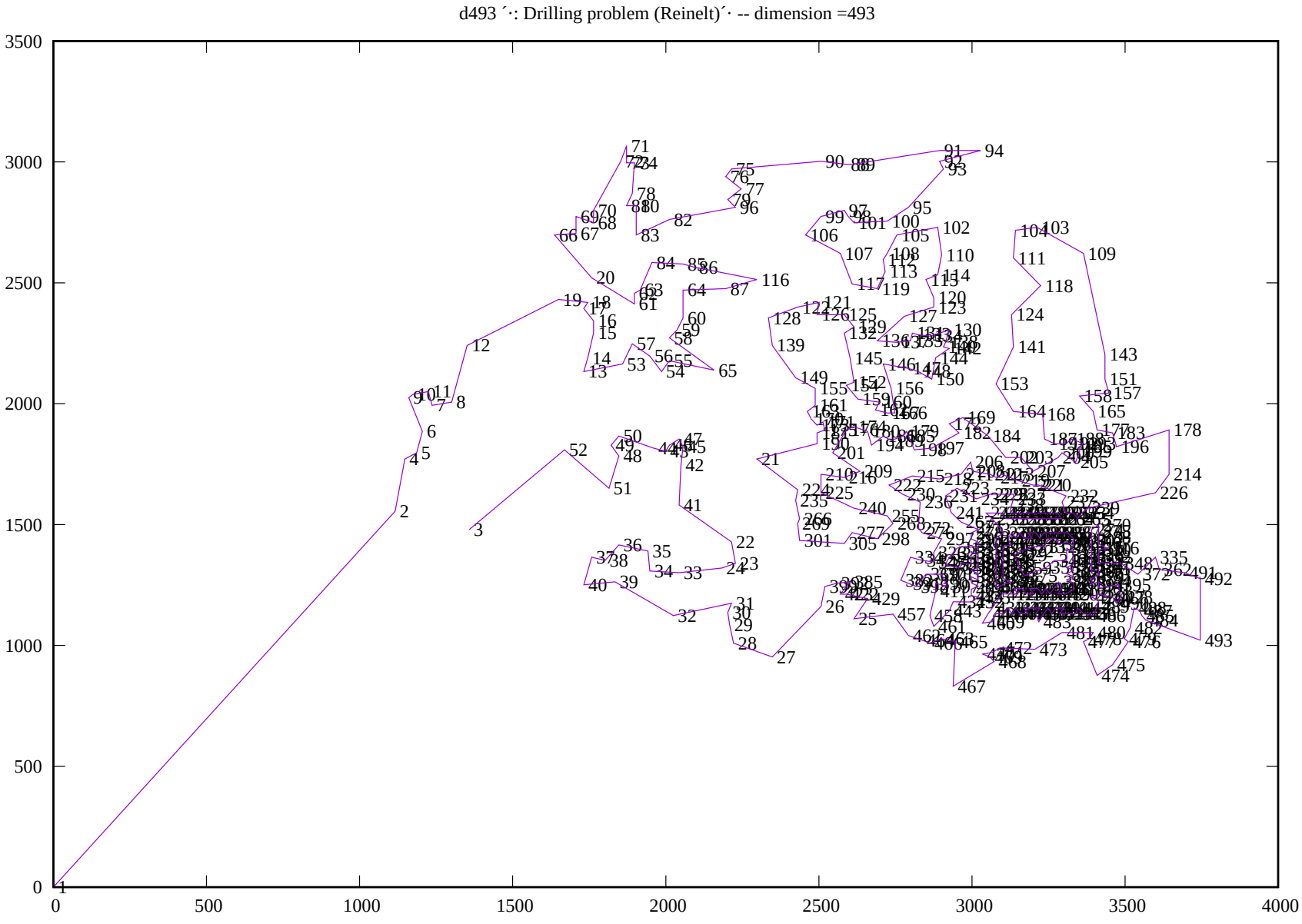
Rastrový výstup přímo z Concorde



NEOS, výstup GnuPlot

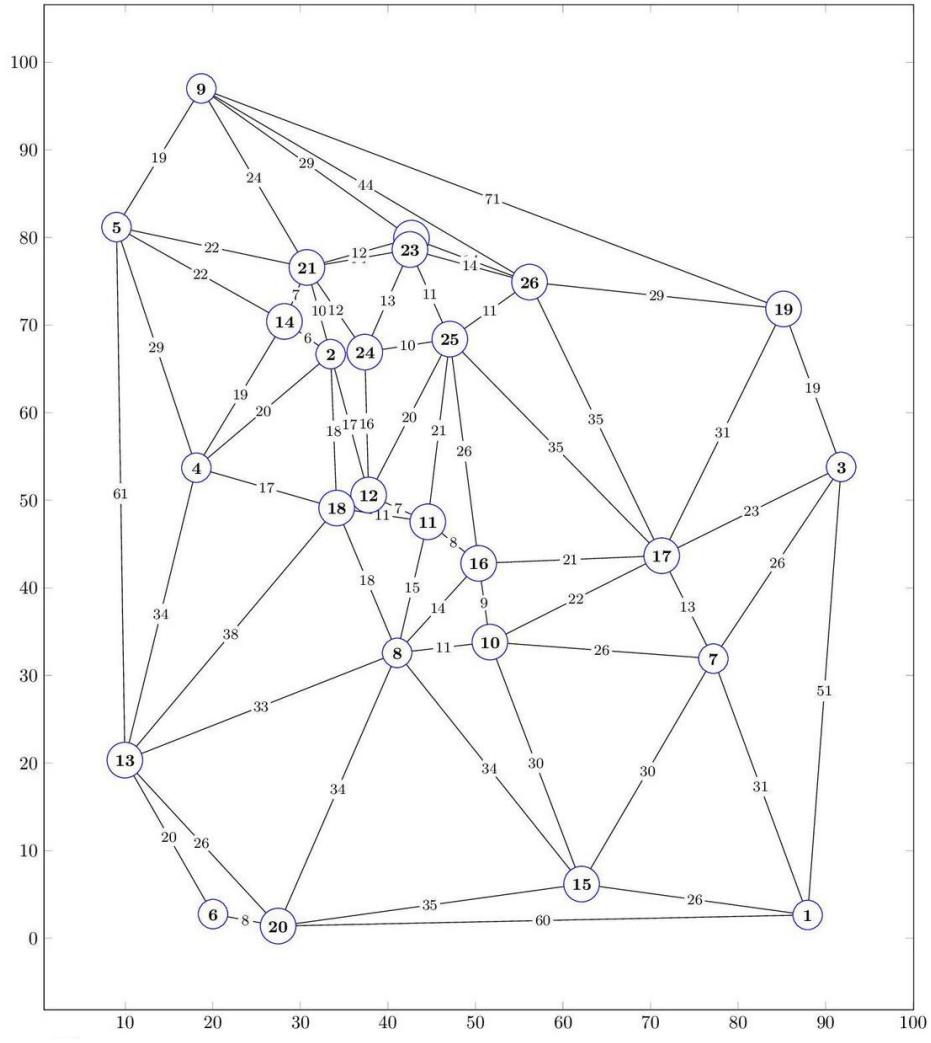


NEOS, výstup GnuPlot

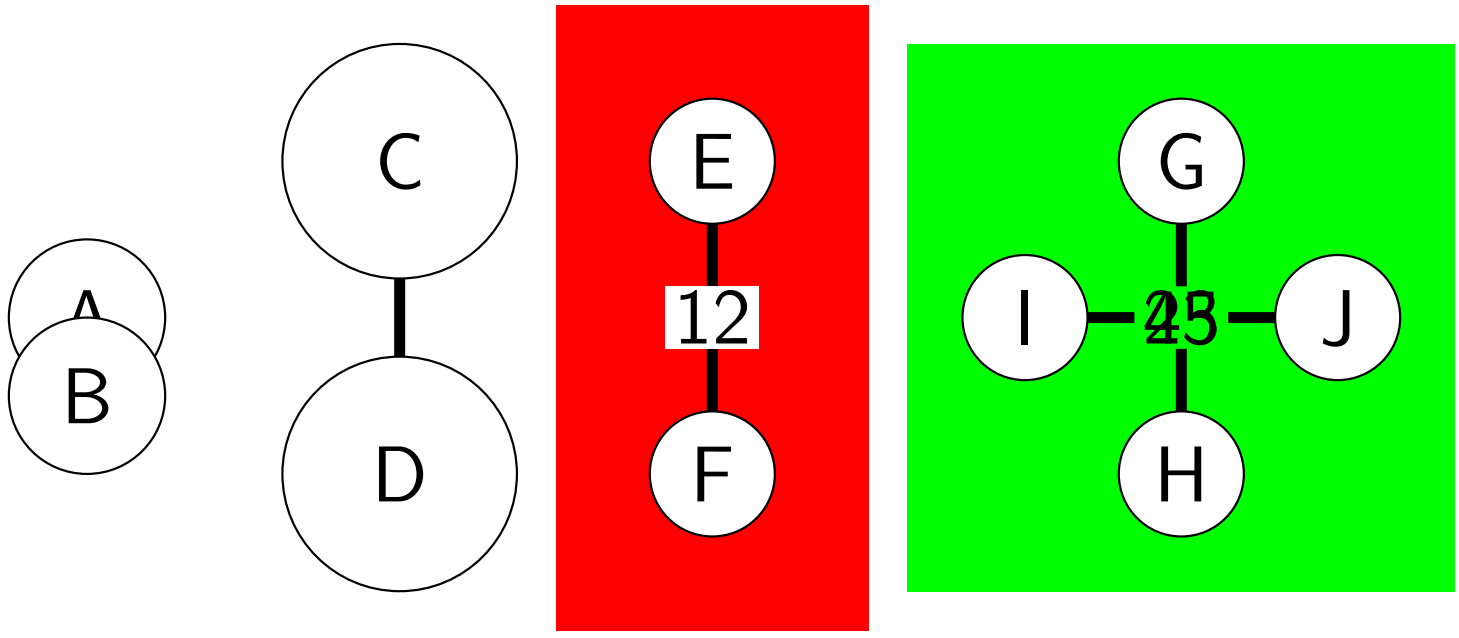


Starý pokus: Lua + pgfplots

https://tex.stackexchange.com/questions/235372/how-to-get-vector-graphics-from-concorde-program



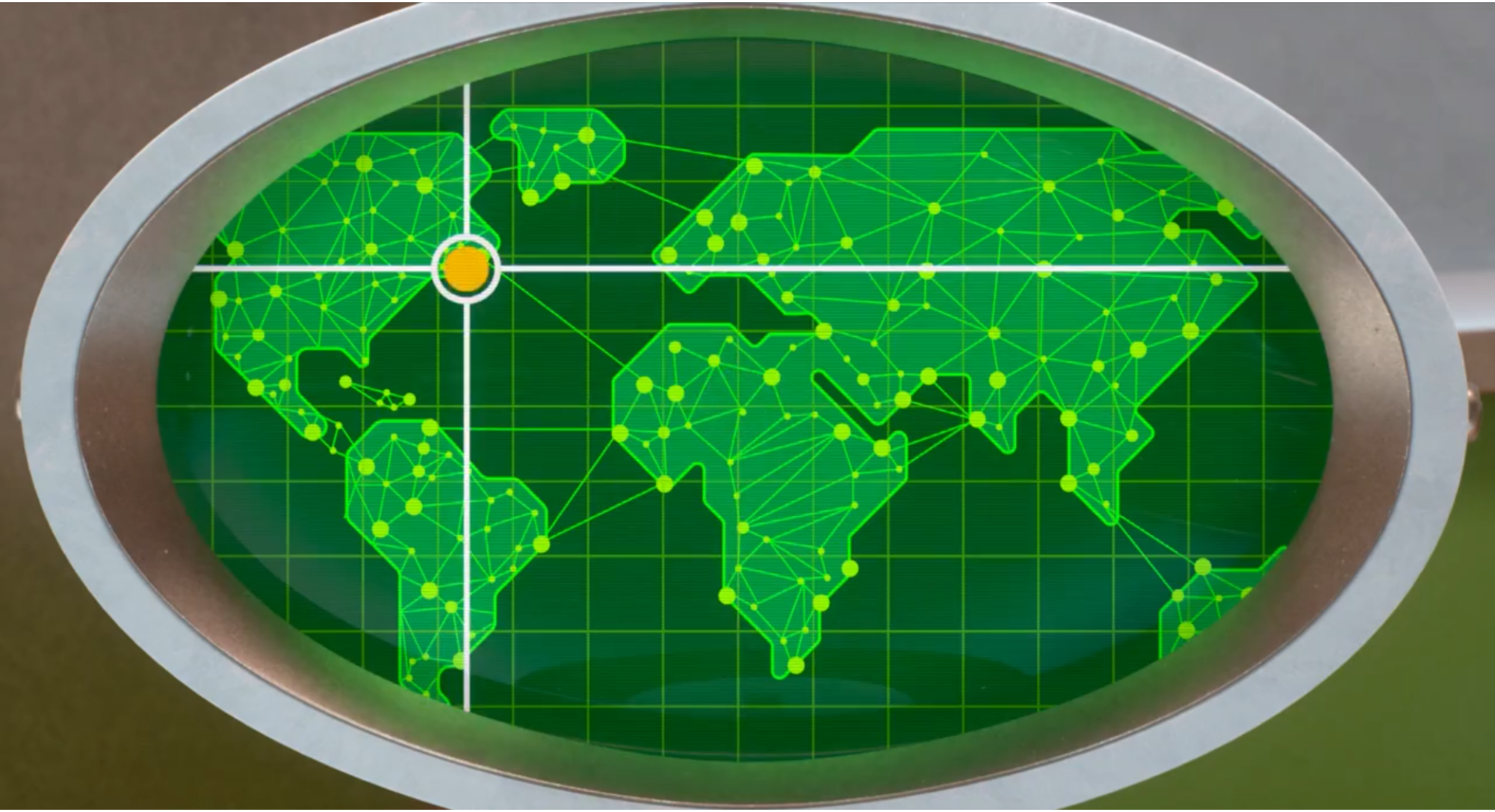
Zlepšováky



Varianty TSP

- Viz článek ve sborníku: Štefan Peško a Zuzana Borčinová.

- Když uzel není bod, ale oblast.
  Reálné mapy: navštívit všechny kraje.
- Když se uzly pohybují.
  Likvidace vesmírného odpadu na oběžné dráze.
- Varianta varianty Michala Kaukiče TSP: Být omezen délkou, ale chceme obejít co nejvíc lokalit z některé z nabízených lokalit.



Varianty TSP

Termíny: *almost optimal*, *nearly fourfold* ap.

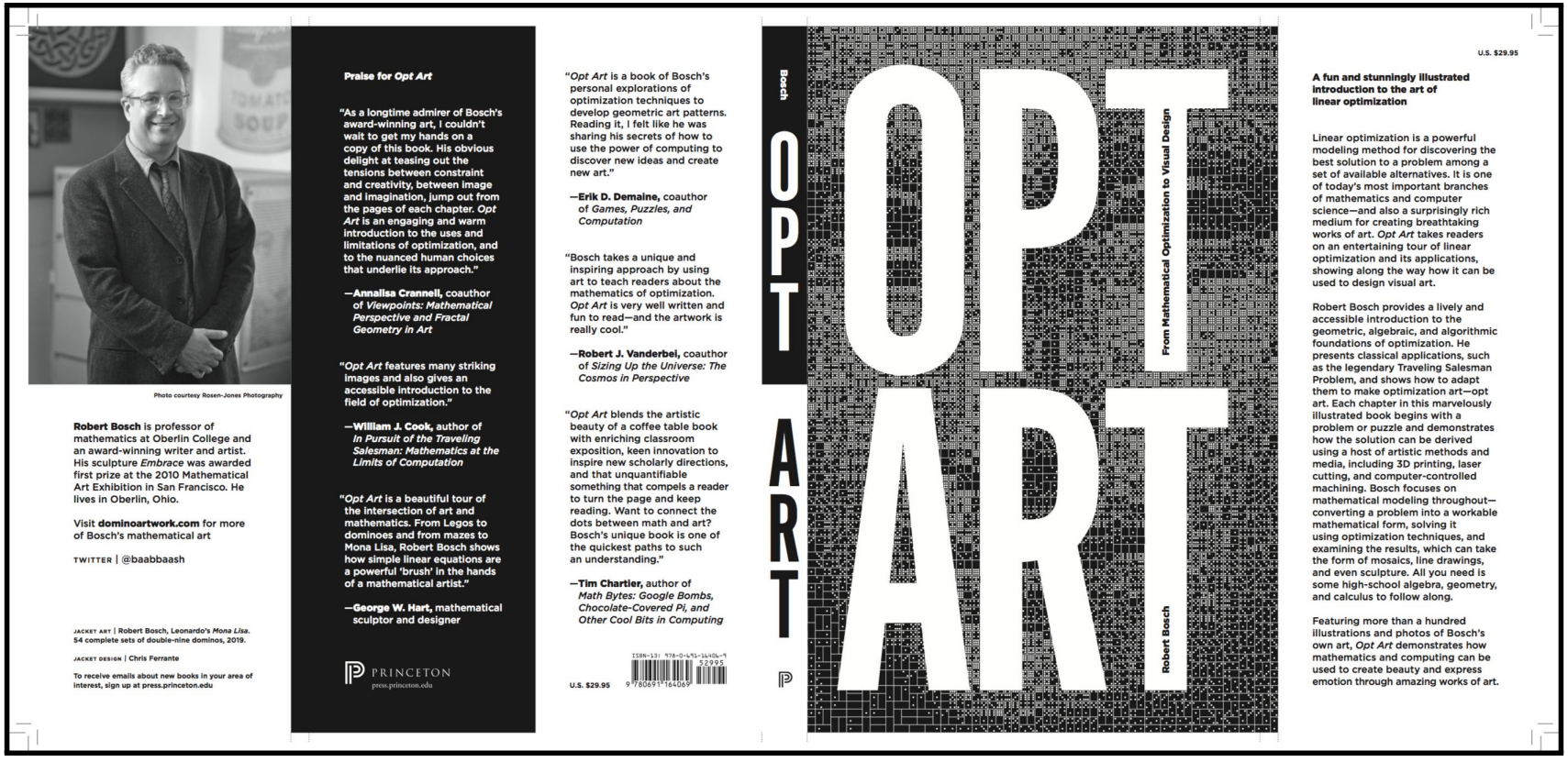


Photo courtesy Rosen-Jones Photography

Robert Bosch is professor of mathematics at Oberlin College and an award-winning writer and artist. His sculpture *Embrace* was awarded first prize at the 2010 Mathematical Art Exhibition in San Francisco. He lives in Oberlin, Ohio.

Visit **dominoartwork.com** for more of Bosch's mathematical art

TWITTER | @baabbaash

JACKET ART | Robert Bosch, Leonardo's *Mona Lisa*. 54 complete sets of double-nine dominos, 2019.

JACKET DESIGN | Chris Ferrante

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Praise for *Opt Art*

"As a longtime admirer of Bosch's award-winning art, I couldn't wait to get my hands on a copy of this book. His obvious delight at teasing out the tensions between constraint and creativity, between image and imagination, jump out from the pages of each chapter. *Opt Art* is an engaging and warm introduction to the uses and limitations of optimization, and to the nuanced human choices that underlie its approach."

—**Annalisa Crannell,** coauthor of *Viewpoints: Mathematical Perspective and Fractal Geometry in Art*

"*Opt Art* features many striking images and also gives an accessible introduction to the field of optimization."

—**William J. Cook,** author of *In Pursuit of the Traveling Salesman: Mathematics at the Limits of Computation*

"*Opt Art* is a beautiful tour of the intersection of art and mathematics. From Legos to dominoes and from mazes to Mona Lisa, Robert Bosch shows how simple linear equations are a powerful 'brush' in the hands of a mathematical artist."

—**George W. Hart,** mathematical sculptor and designer

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"*Opt Art* is a book of Bosch's personal explorations of optimization techniques to develop geometric art patterns. Reading it, I felt like he was sharing his secrets of how to use the power of computing to discover new ideas and create new art."

—**Erik D. Demaine,** coauthor of *Games, Puzzles, and Computation*

"Bosch takes a unique and inspiring approach by using art to teach readers about the mathematics of optimization. *Opt Art* is very well written and fun to read—and the artwork is really cool."

—**Robert J. Vanderbei,** coauthor of *Sizing Up the Universe: The Cosmos in Perspective*

"*Opt Art* blends the artistic beauty of a coffee table book with enriching classroom exposition, keen innovation to inspire new scholarly directions, and that unquantifiable something that compels a reader to turn the page and keep reading. Want to connect the dots between math and art? Bosch's unique book is one of the quickest paths to such an understanding."

—**Tim Chartier,** author of *Math Bytes: Google Bombs, Chocolate-Covered Pi, and Other Cool Bits in Computing*

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52995
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Bosch

OPT ART

From Mathematical Optimization to Visual Design

Robert Bosch

U.S. $29.95

A fun and stunningly illustrated introduction to the art of linear optimization

Linear optimization is a powerful modeling method for discovering the best solution to a problem among a set of available alternatives. It is one of today's most important branches of mathematics and computer science—and also a surprisingly rich medium for creating breathtaking works of art. *Opt Art* takes readers on an entertaining tour of linear optimization and its applications, showing along the way how it can be used to design visual art.

Robert Bosch provides a lively and accessible introduction to the geometric, algebraic, and algorithmic foundations of optimization. He presents classical applications, such as the legendary Traveling Salesman Problem, and shows how to adapt them to make optimization art—opt art. Each chapter in this marvelously illustrated book begins with a problem or puzzle and demonstrates how the solution can be derived using a host of artistic methods and media, including 3D printing, laser cutting, and computer-controlled machining. Bosch focuses on mathematical modeling throughout—converting a problem into a workable mathematical form, solving it using optimization techniques, and examining the results, which can take the form of mosaics, line drawings, and even sculpture. All you need is some high-school algebra, geometry, and calculus to follow along.

Featuring more than a hundred illustrations and photos of Bosch's own art, *Opt Art* demonstrates how mathematics and computing can be used to create beauty and express emotion through amazing works of art.

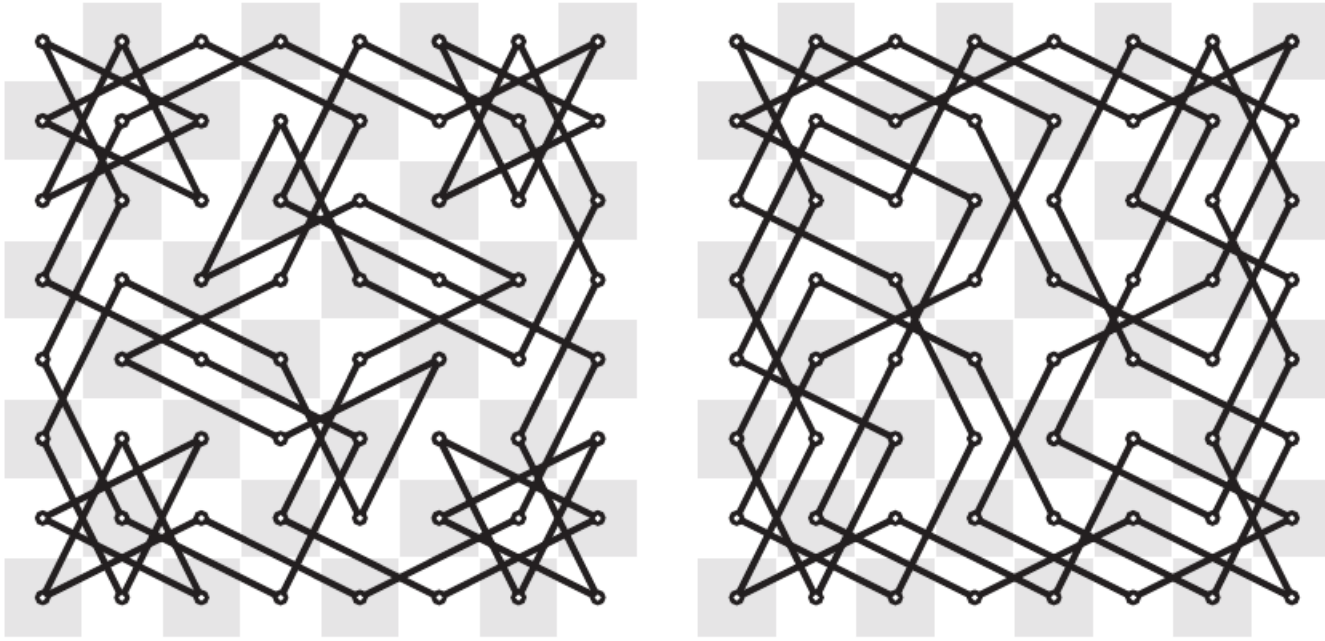


Figure 8.4: Two more nearly fourfold knight's tours.

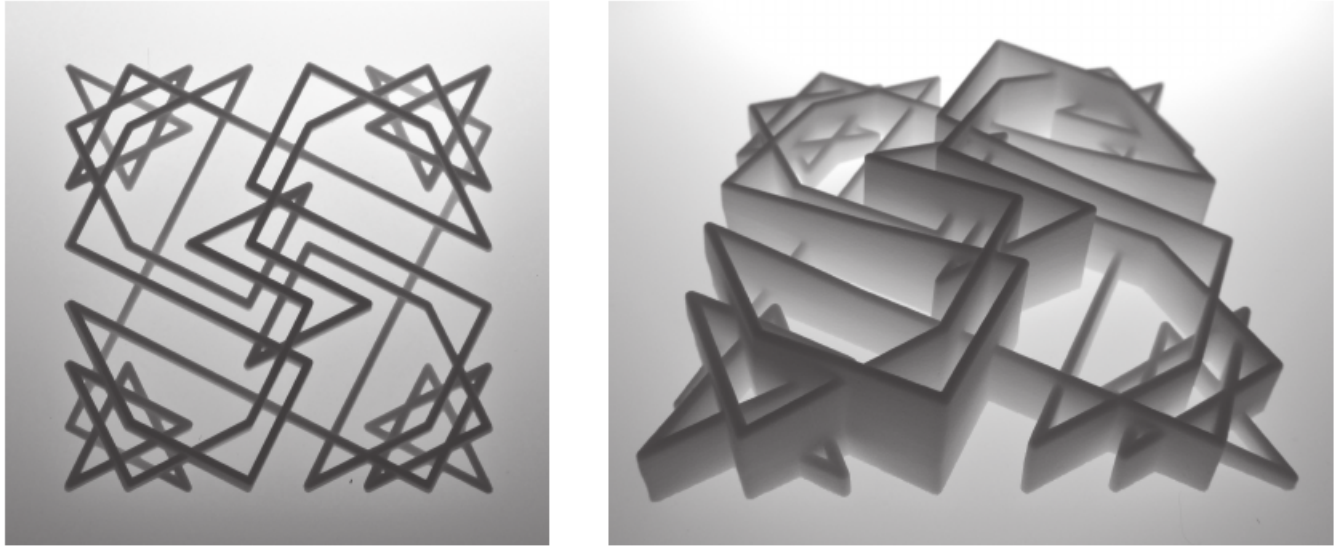


Figure 8.5: A 3D-printed nearly fourfold knight's tour.

Jsou-li otázky. . .

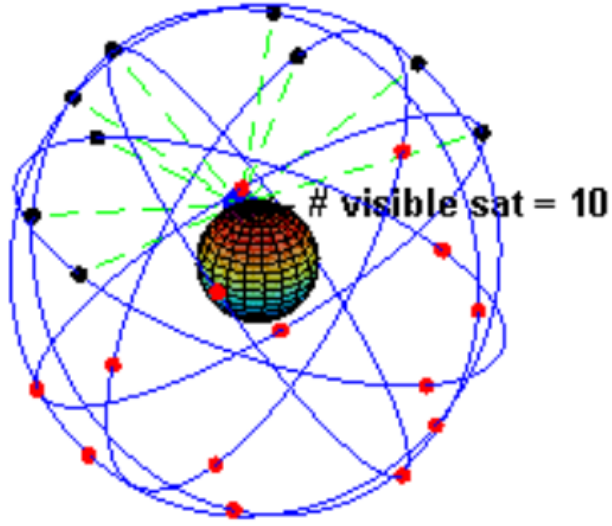
25. narozeniny kešek

Pavel Stříž, pavel@striz.cz

OSSConf, 1. – 3. 7. 2025

Můj první kontakt

- Prosba spolužáka o vyřešení satelitní řady.
- Dlouhé měsíce nad iGPS, keškou GC2JE7V.
- Vyřešena 17. 1. 2021.



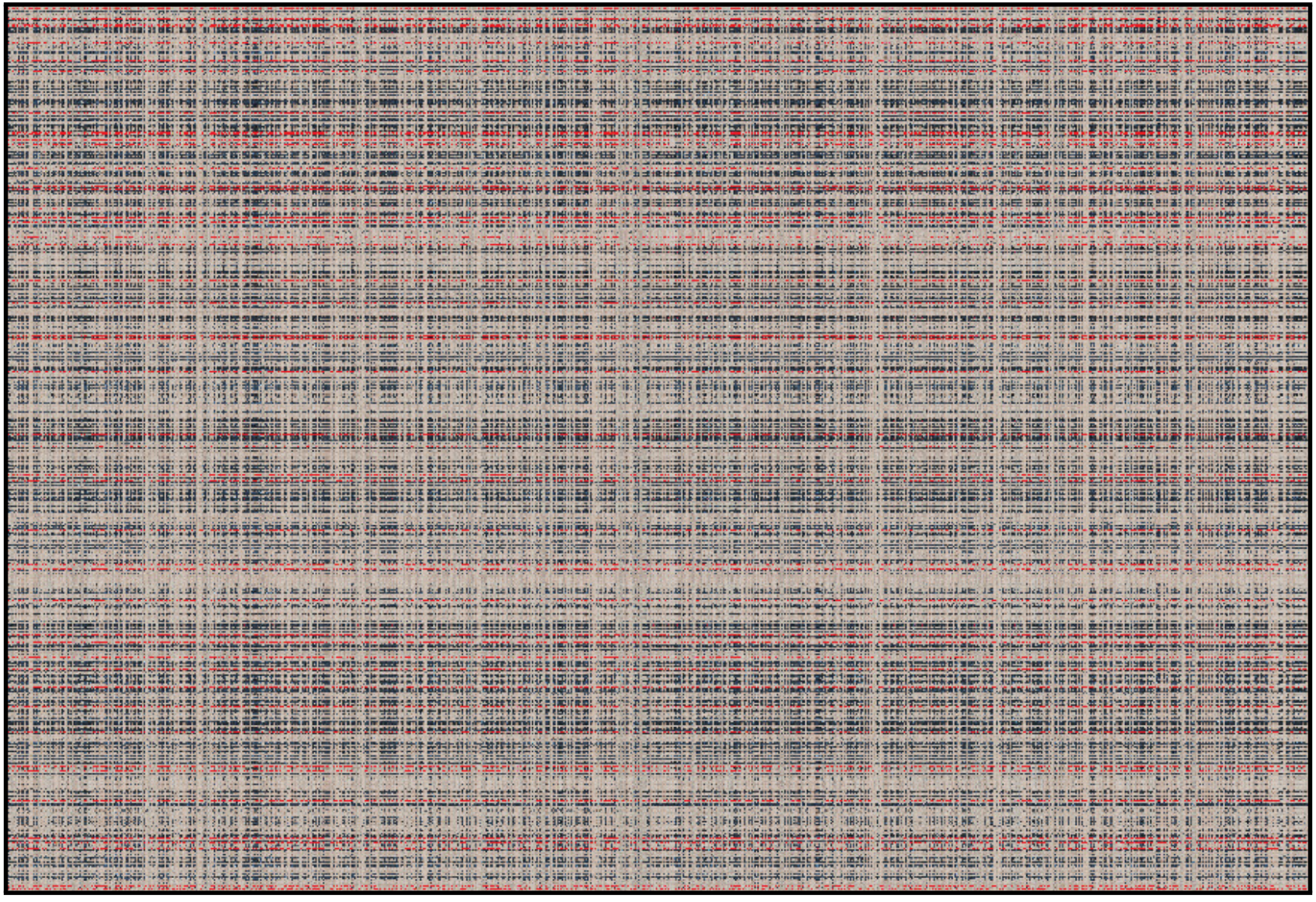
TSP

- Prosba spolužáka o vyřešení úloh s proházenými řádky/sloupci rastrových obrázků.
- Úloha vede na TSP, pak řada softwarových překážek.
- Jsou to kešky GCB78KB, GCB78MA a GC8RXDE.
- Vyřešeny 6. 6. 2025.
- V článku je zmíněn návod.

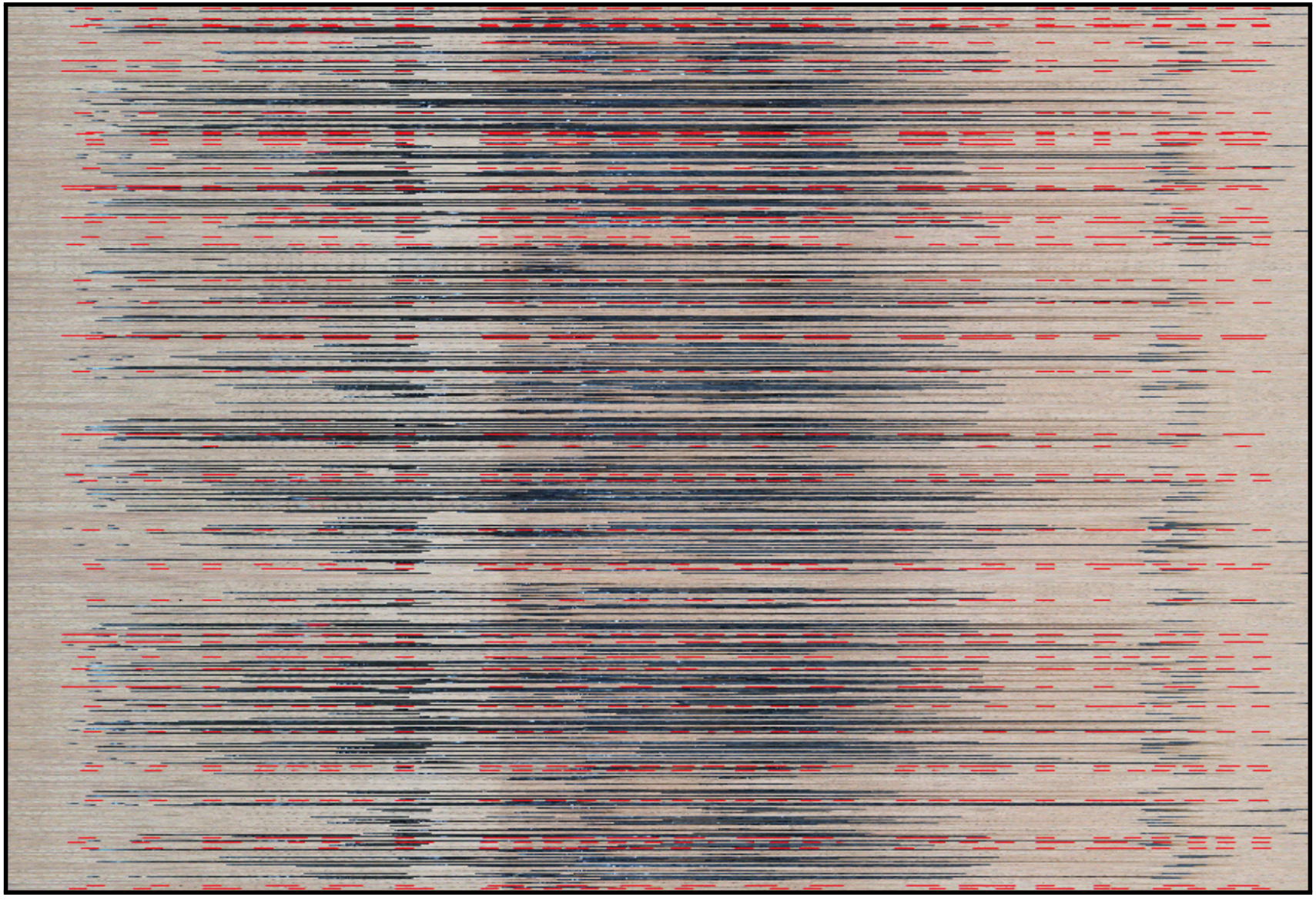
Keška GCB78KB

Keška GCB78KB

Keška GCB78MA

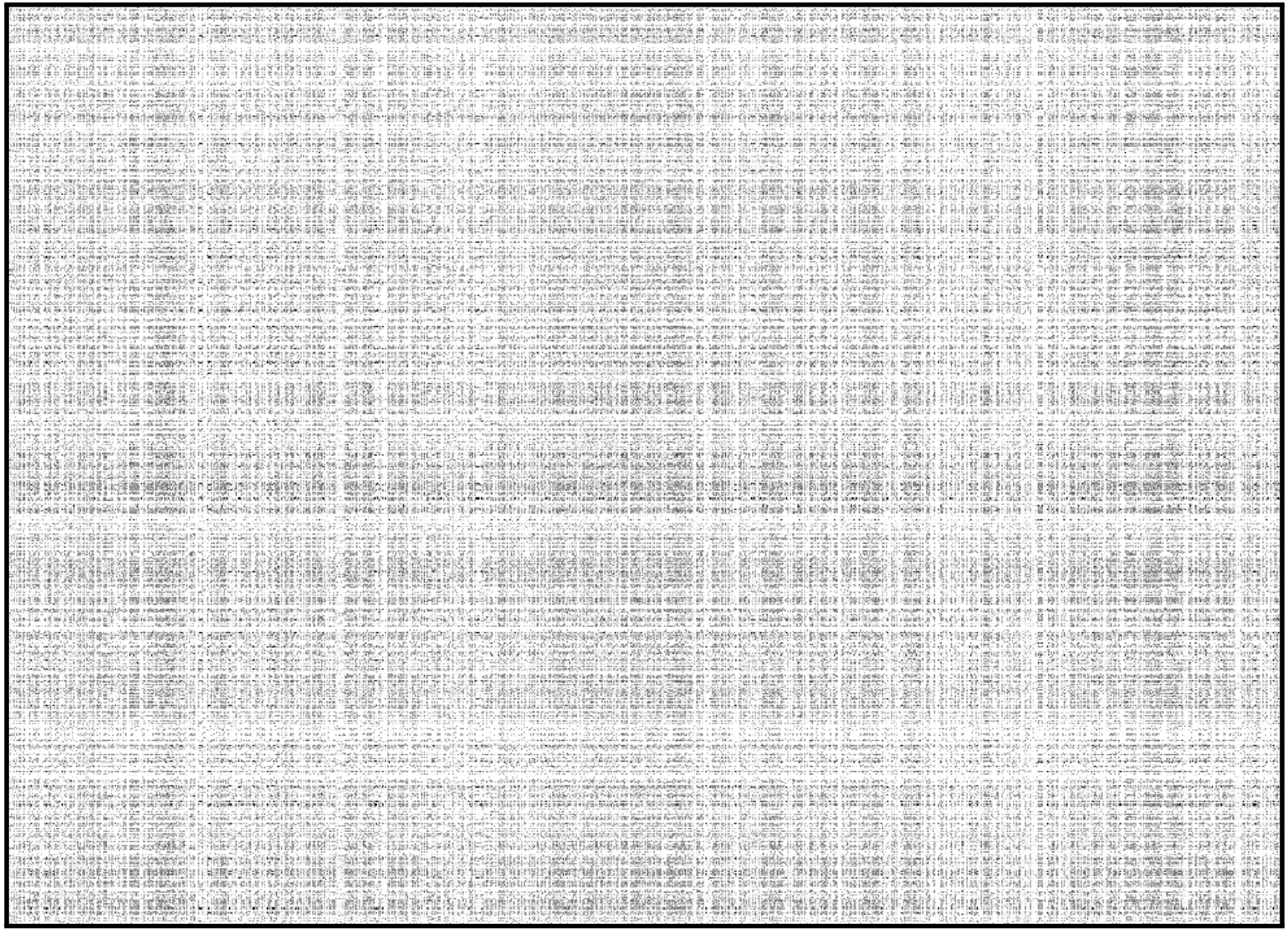


Keška GCB78MA



Keška GCB78MA

Keška GC8RXDE, nápověda byla:
Jedna z $980! \times 707!$ možností...



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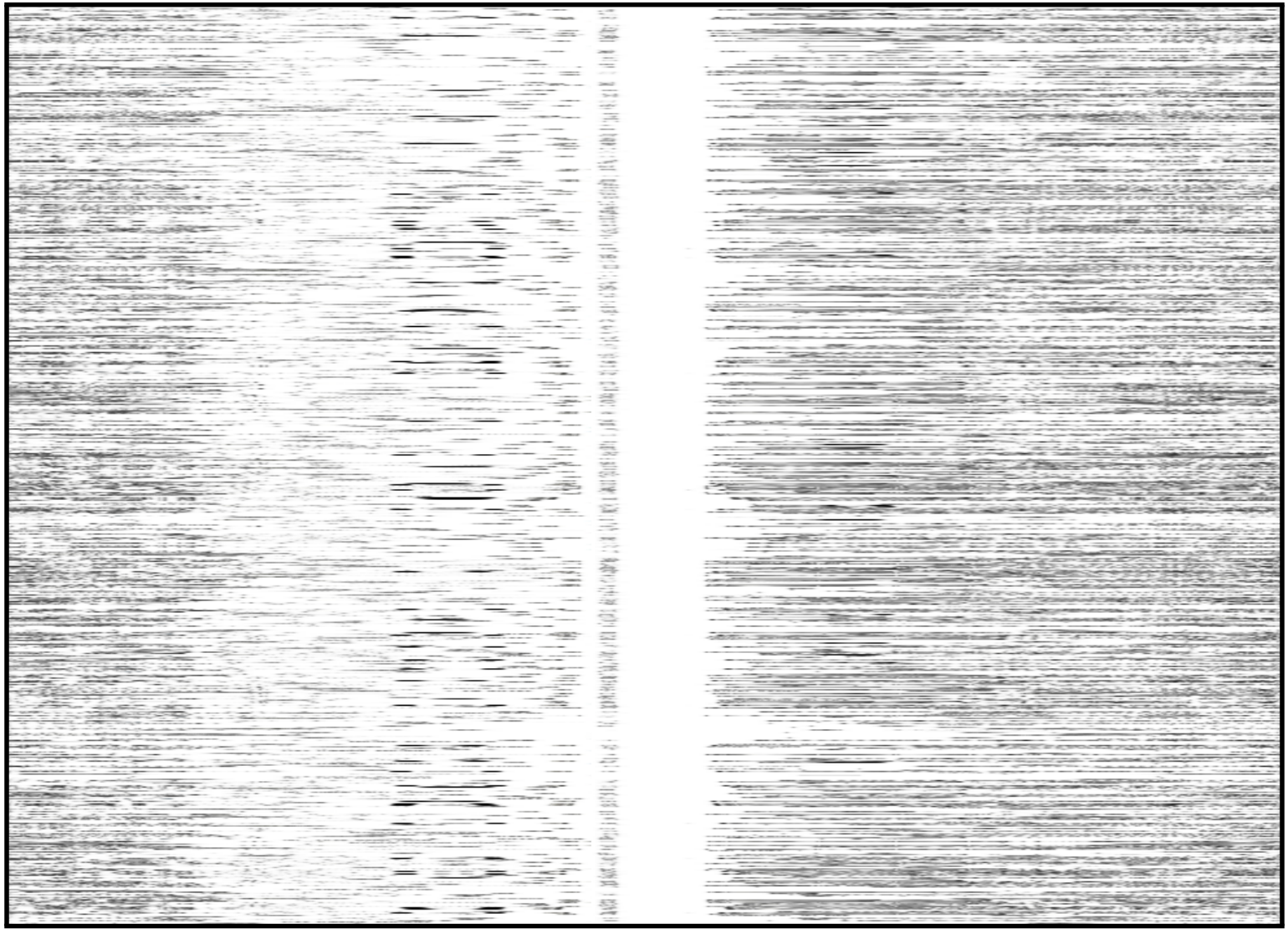
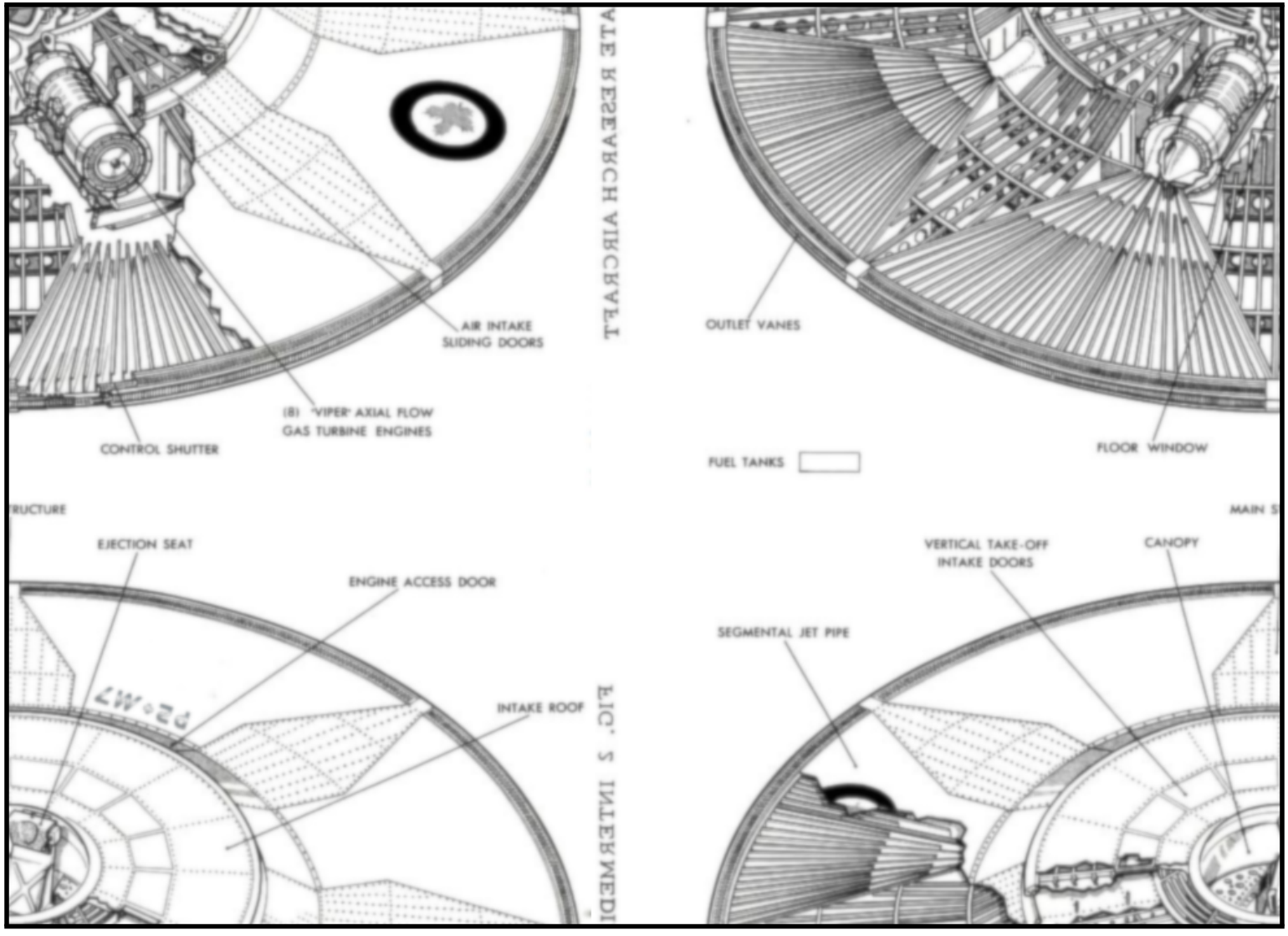
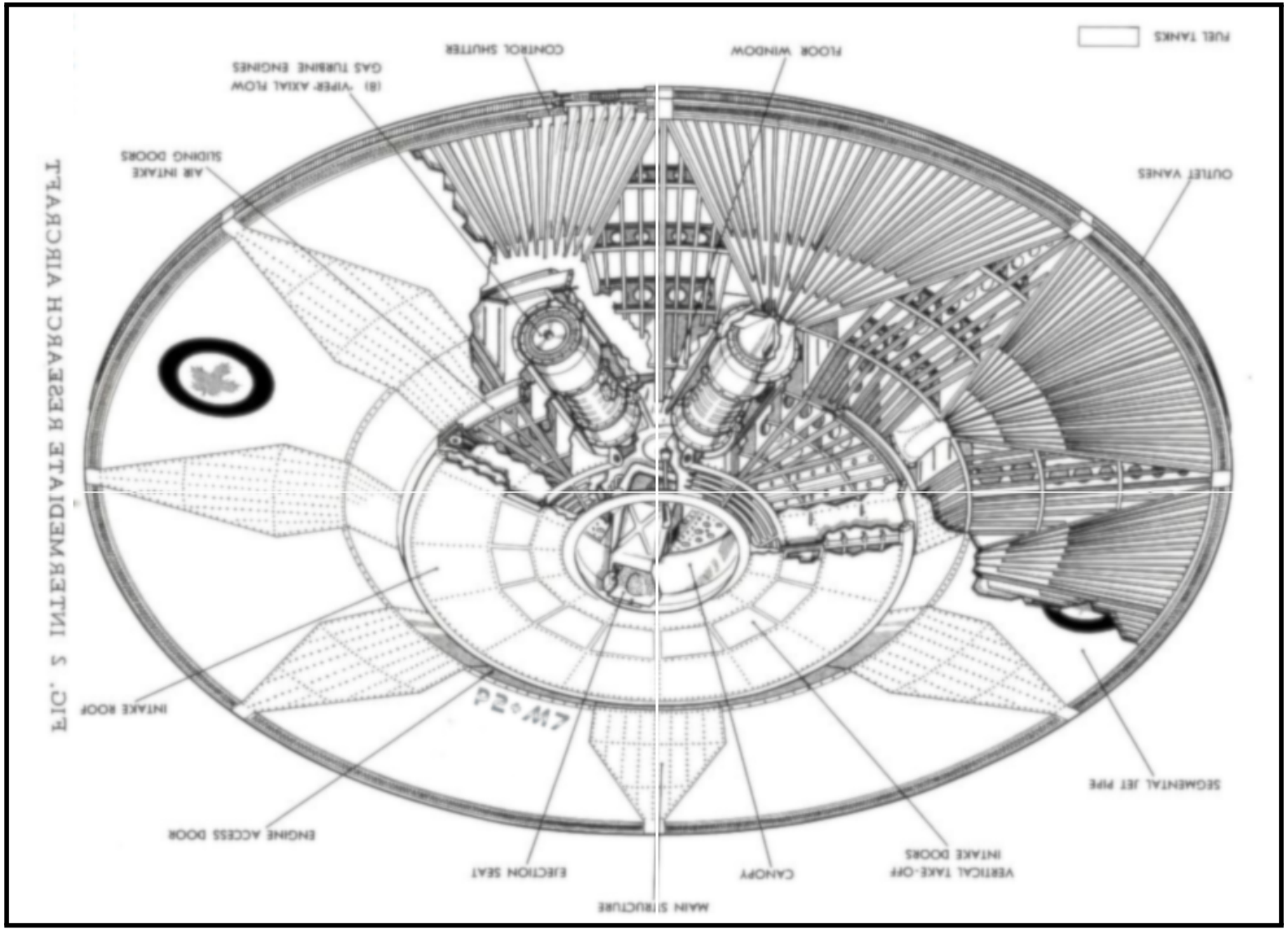


Keška GC8RXDE, nápověda byla: Jedna z 980! × 707! možností...



Keška GC8RXDE, nápověda byla: Jedna z 980! × 707! možností...



Otevřený problém č. 1

Lze vizualizovat obecnou matici vah/vzdáleností?

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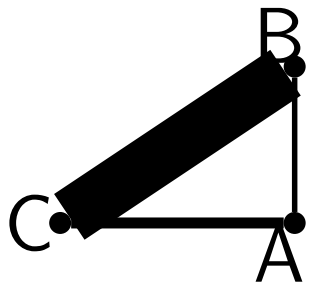
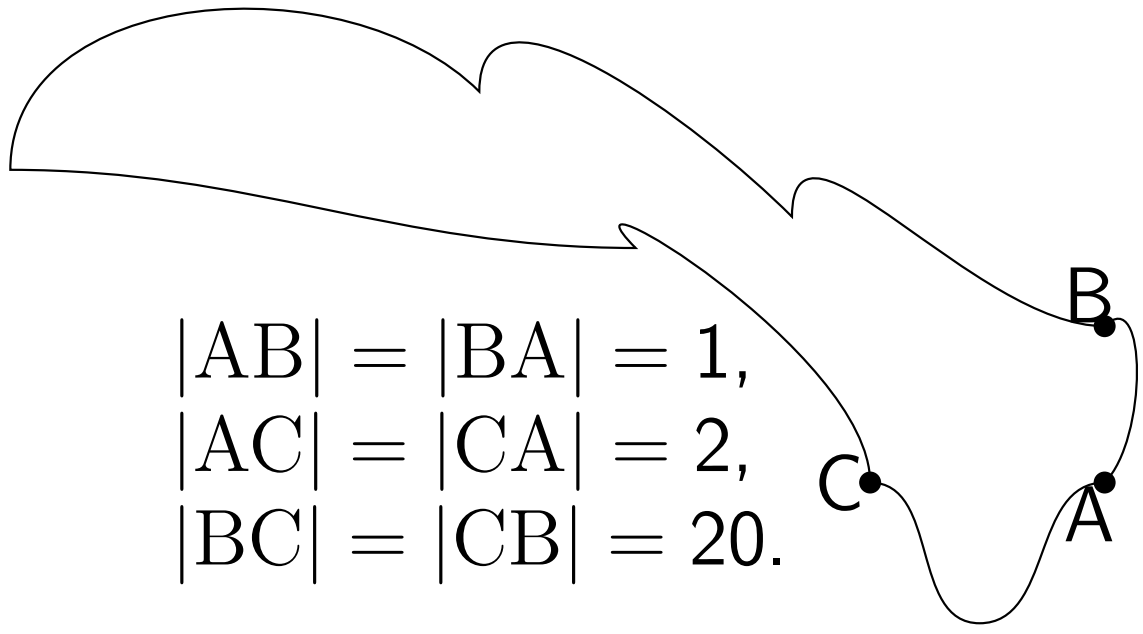
Nápad 1: síla linek jako váha



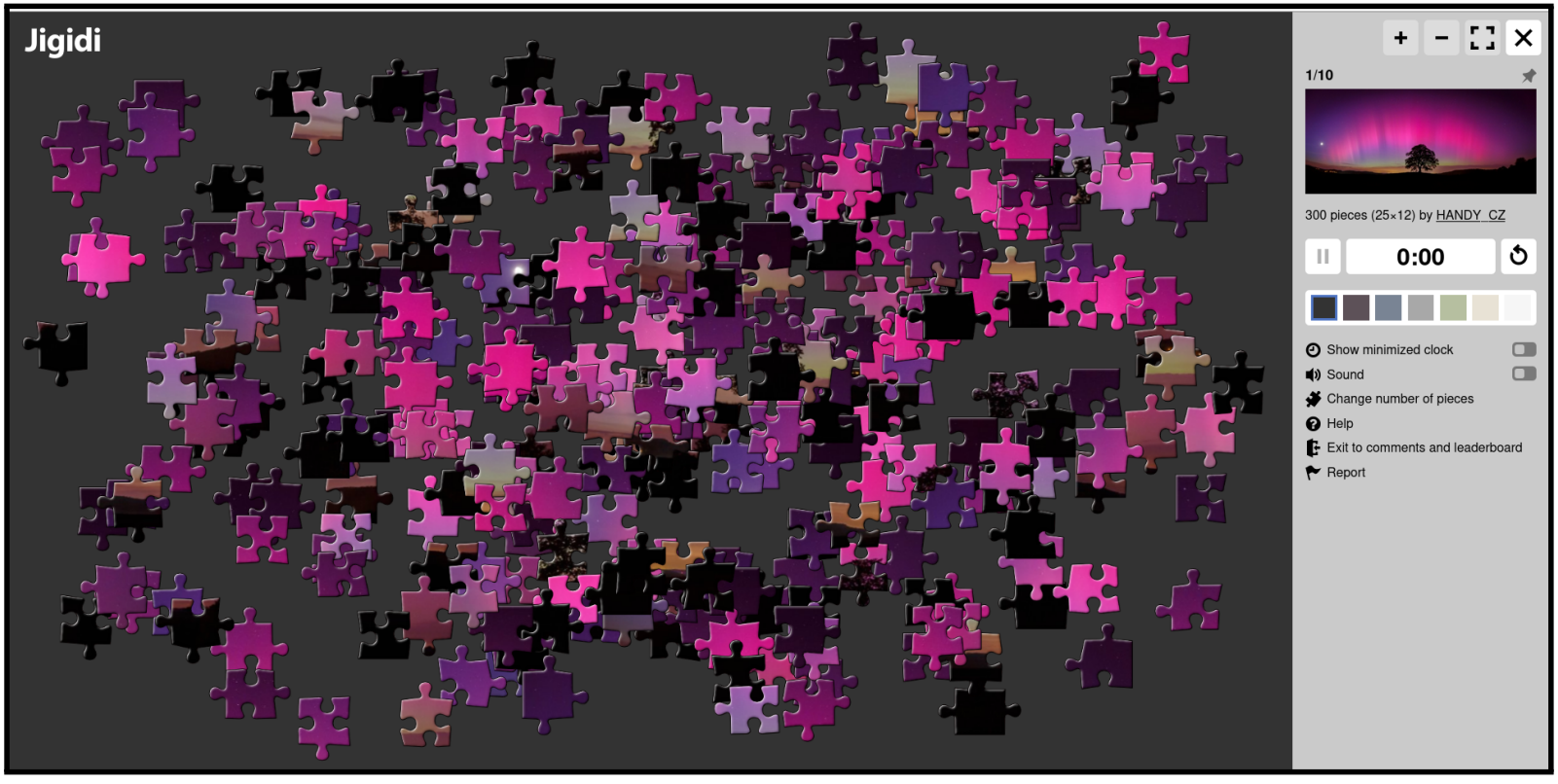
Nápad 2: kroucení cest



$$|\mathrm{AB}| = |\mathrm{BA}| = 1,$$
$$|\mathrm{AC}| = |\mathrm{CA}| = 2,$$
$$|\mathrm{BC}| = |\mathrm{CB}| = 20.$$

Otevřený problém č. 2, pro hackery

Lze zautomatizovat řešení puzzle na jigidi.com? Např. `jigidi.com/solve/92zdkwnh/1-10/` pro kešku GCAQJ2E.



Děkuji za pozornost!